SEMINAR PROPOSAL DEFENCE
ON
APPARATUS FOR DEMONSTRATION OF NATURAL FREQUENCY OF A VIBRATING BODY

BY

GROUP 5

(Okeke Michael Chukwubuikem, Agba Bekwuhapu Sylvester, Okauwu Loveday Emmanuel, Alali-Michael Favour Kingsley, Adah Favour Tabi, Iheanacho Justin Chinweze, Ujaga Joemary Anorishor, Ogbonna Nkechukwu Chukwuemeka)

DEPARTMENT OF MECHANICAL ENGINEERING
FACULTY OF ENGINEERING AND TECHNOLOGY
UNIVERSITY OF CALABAR
CALABAR.

MARCH 2024

TABLE OF CONTENTS

CHAPTER ONE
INTRODUCTION

1.1 BACKGROUND OF STUDY

Some bodies in nature, and in mechanical systems are in vibrating state; either by force or naturally. An excited body tends to vibrate at its natural frequency. The natural frequency can be actualized by disturbance or by finding resonance with an induced force. At the resonating frequency there is a high amplitude in the vibration which can be dangerous to engineering structures.

That is why this project work will be focused on the design, fabrication and analysis of an apparatus for determining the natural frequency of a vibrating body. The natural frequency of a vibrating body is a fundamental property, which helps us to understand the dynamic behaviour of the vibrating body. Besides that, this data can also be used to validate the accuracy of theoretical calculations and for the design of the vibrating system in various engineering applications. For example, technologies that absorb or suppress vibrations, such as shock absorbers, vehicle suspensions, and vibration isolator systems, are all based on the principle of tuning the system to work most effectively at a particular natural frequency. In terms of the intellectual merit, the study proceeds according to scientific method. This involves the recognition and statement of the problem, designing and fabrication of the apparatus as well as the analysis and interpretations of data and reporting. The steps are going to be discussed and reviewed.

1.2 STATEMENT OF THE PROBLEM

There are many problems in Nigerian institutions of which one of them is the lack of practical equipment in the laboratories/workshops for practicals. Like other universities in Nigeria, the department of mechanical engineering in University of Calabar, Calabar, Cross River State is one of the departments facing such challenge. The apparatus that will be produced at the end of this project work will help solve part of the problem by providing the apparatus for the students in the department to carry out their practicals

1.3 AIMS AND OBJECTIVES

- To fabricate apparatus that can perform almost all transverse vibration experiments.
- To have and apparatus with the ability to study response of beams of various material and various length under excitation for different end conditions
- To enable the natural frequency of a given vibrating body to be determined

1.4 SIGNIFICANCE OF THE STUDY

This study is significant because knowledge and the ability to determine the natural frequency of a vibrating body are crucial. Some solutions of problems in engineering too require that we consider and we find out what are the natural frequencies in the proposed designs. This determined natural frequency can be used to make sure objects and structure never gets to a point of a disturbance frequency whereby it get destroyed. Armed with the natural frequency knowledge one can decide to replicate it or hamper it.

1.5 SCOPE OF THE STUDY

The journey to execute the production of this apparatus brushes through several aspects of engineering. The aspects includes the following:

- Design and fabrication
- Wave motion
- Simple harmonic motion, etc.

Despite the reach of this project, we will not strike the aspects of unbalanced force, damping and resonation, even though they have a level of impact on this study. But then again it can be a bedrock for further exploration.

CHAPTER TWO
LITERATURE REVIEW

In 2001, Gurgoze and H. Erol obtained frequency response function through a formula, which was established for the reacceptance matrix of discrete systems subjected to linear constraint equations.

Marek Pietrzakowski in 2002 investigated experimentally as well as numerically active effects of cantilever beam transverse vibrations. Experimental results of free and forced vibrations confirmed the effectiveness of the control circuit with analog derivative controller for suppression of low frequency beam motion.

Chih Ling Huang, et al. (2005) rotating beams are often used as a simple model for propellers, turbine blades, and satellite booms. The free vibration frequencies of rotating beams have been extensively studied.

According to R. Lassoued and M. Guenfoud (2005) there is an accurate procedure to determine free vibrations of beams and plates. The natural frequencies are exact solutions of governing vibration equations which load to a nonlinear homogeny system.

D. R. Prasad and D. R. Seshu (2008) carried out modal analysis on structural materials which is a process of describing a structure in terms of its natural characteristics which are the frequency, damping and mode shapes –its dynamic properties.

CHAPTER 3
MATERIALS AND METHODS

3.1 APPARATUS COMPONENTS

The following components are necessary for the design and fabrication of this measuring apparatus, and they include:
Frame
Rectangular beam
Spring
Recording pen
Recording drum.

3.2 CHOICE OF MATERIAL

The choice of material is necessary for the fabrication of any apparatus, so we quickly take that into play. The frame, beam, and spring is to be metallic, and the recording drum is to have installed on it, an ink responsive surface.

3.3 SEQUENCE OF ASSEMBLY

The frame is to have the beam pinned at one end, and attached to a spring (assembled from the top of the frame) at the other, close to the opposite end of the frame. The beam is to behave like a cantilever and its recording pen is attached along this beam so its recording can be done on a recording drum which is attached from the top of the frame.
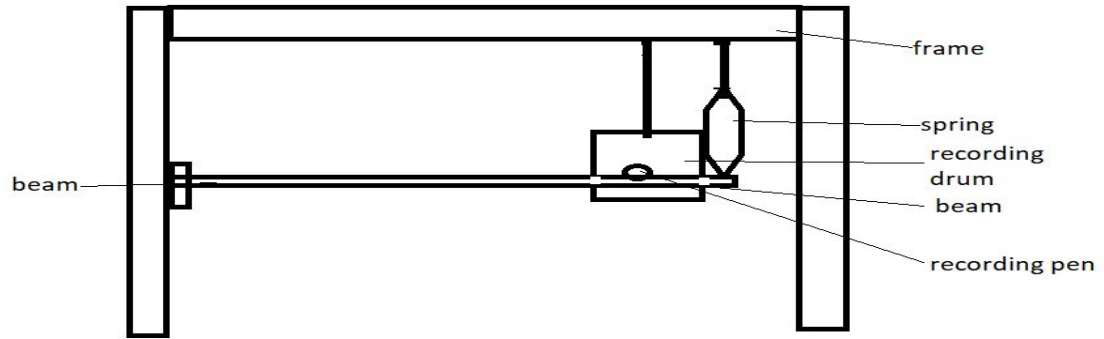
FIG 1: Diagram of the natural frequency measuring apparatus

3.4 WORKING PRINCIPLE

The instrument represented in the diagram can measure the natural frequency. The principle is based on rate of the repeated vibration per unit time. When the beam is disturbed and on a stabilized frequency, the record pen also follows the motion of the beam as the spring helps the beam restore the force of motion. This record pens up-down motion is reflected on the recording drum as the record pen itself moves the sheet at a certain speed. With the help of a timer, and the record drum able to show the number of cycles, this enables the aparatus to determine the natural frequency of the vibrating body.

CHAPTER 4
EXPECTED RESULT

This equipment should be able to measure the natural frequency of a body upon stabilization to at least 95 percent accuracy. In addition to that, the amplitude of this vibration can be taken to study, even though the wavelength on this self produced graph seem to be provided by the revolution of the recording drum.

With the frame able hold all the components loaded on it effectively, and the timing system used alongside our apparatus should further improve accuracy.

CHAPTER FIVE
CONCLUSION

On the production of an apparatus of this caliber, the capital is intensive. On the grounds of this, necessary modifications has been made to the similar on-ground apparatus and it creates room for critique and improvement.

We need this apparatus of this caliber for research on material characteristics especially in the field of harmonic motion.
I believe it will be a big plus to the body of knowledge, and also our soon to be alma mater.

Thank you for listening.

REFERENCES

C. L. Huang, W. Y. Lin and L. M. Hsio, (2005), "Free vibration analysis of rotating euler beams and high angular velocity", Dept. of Mechanical Engineering; National Chiao Tung University,, Hsinchu Tiawan 14 Nov.

D. Ravi Prasad and D.R. Seshu, (2008)"A study on dynamic characteristics of structural materials using modal analysis", Asian Journal of Civil Engineering, Volume 9, Number 2, Pages 141-152.

M. Gugrgogze and H. Erol, (2002) "On the frequency response function of a damped cantilever simply supported in-span and carrying a tip mass", journal of sound and vibration 255(3), 489-500.

M. Gurgoze and H.Erol, (2001), "Determination of the frequency response function of cantilever beam simply supported –In span ", Journal of Sound & Vibration, Pages 372-378.

Marek Pietrzakowski, (2002)"Experiment on a cantilever beam control and theoretical approximation", Journal of theoretical and applied mechanic, Volume 40(3).

R. Lassoued and M Guenfoud, (2005)"Accurate calculation of free frequencies of beams & rectangular plats", world academy of science Engg. & Technology at 10.